Appendix D

The existing noise environment in Milpitas was characterized by a noise monitoring and measurement program conducted between Tuesday, November 30 and Wednesday, December 1, 1993. All measurements and monitoring employed Larson Davis Model 700 digital programmable noise monitors. These devices were housed in weatherproof containers, and programmed to digitally record the noise environment at each location, at half - second intervals, throughout the noise monitoring period. Two control sites were selected: Site 1 was along I-880, 180 feet east of the roadway centerline, north of Route 237; Site 2 was located along I-680, 160 feet east of the roadway centerline, west of Shirley Drive. Each of these monitoring systems operated concurrently during an identical time period between November 30 and December 1, 1993. The detailed monitoring data results are attached and summarized in Table D1

Four additional 1-minute duration noise measurements were at the other four measurement locations (sites 3, 4, 5 and 6 on November 30; see Table D-1). The description of each measurement location is given in the table along with summary noise measurement results.

Table D-1 is followed by background information on noise and physiological responses to noise.

Fundamental Concepts of Community Noise

Background

Three aspects of community noise are important in determining subjective response:

- Level (i.e., magnitude or loudness) of the sound.
- The frequency composition or spectrum of the sound.
- The variation in sound level with time.

Airborne sound is a rapid fluctuation of air pressure and local air velocity. Sound levels are measured and expressed in decibels (dB) with 0 dB roughly equal to the threshold of hearing.

The frequency of a sound is a measure of the pressure fluctuations per second measured in units of hertz (Hz). Most sounds do not consist of a single frequency, but are comprised of a broad band of frequencies differing in level. The characterization of sound level magnitude with respect to frequency is the sound spectrum. A sound spectrum is often described in octave bands which divide the audible human frequency range (i.e., from 20 to 20,000 Hz) into ten segments. Figure D-1 shows a range of sound spectra for various types of sound over the audible hearing range.

TABLE D-1
Summary of Noise Measurements for the City of Milpitas
Tuesday, 30 November 1993 - Wednesday, 1 December 1993

Site	Location	Date/Time	A-weighted Noise Levels L_{eq}	L_{10}	L_{50}	L_{90}	DNL
1	I-880, 180 ft east of roadway centerline, north of Route 237	30 November - 1 December 1993 Noon	73	75	72	62	77
2	I-680, 160 ft east of roadway centerline, west of Shirley Drive	30 November - 1 December 1993 Noon	75	77	74	65	79
3	Landess Avenue, 50 feet north of roadway centerline, across from Paris Way	30 November 1993 1:40 - 1:55 p.m.	66	70	62	52	70*
4	Dixon Landing Road, 65 feet south of roadway centerline, west of Milmont Drive	30 November 1993 Noon - 12:15 p.m.	68	72	65	60	72*
5	Piedmont Road, 40 feet west of turning lane centerline, 2271 Mesa Verde Drive	30 November 1993 1:30 - 1:45 p.m.	64	69	57	44	68*
6	N. Milpitas Blvd., 65 feet east of turning lane centerline, north of Arbor Lane	30 November 1993 12:30 - 12:45 p.m.	69	72	66	61	73*

*These DNL values are extrapolated from shorter-duration measurements.

Frequency Weighting

Many rating methods exist to analyze sound of different spectra. The simplest method is generally used so that measurements may be made and noise impacts readily assessed using basic acoustical instrumentation. This method evaluates all frequencies by using a single weighting filter that progressively de-emphasizes frequency components below 1000 Hz and above 5000 Hz. This frequency weighting, shown in Figure D-2, reflects the relative decreased human sensitivity to low frequencies and to extreme high frequencies. This weighting is called A-weighting and is applied by an electrical filter in all U.S. and international standard sound level meters. Some typical A-weighted sound levels are presented in Figure D-3.

Noise Exposure

Noise exposure is a measure of noise over a period of time, whereas noise level is a single value at an instant in time. Although a single sound level may adequately describe community noise at any instant in time, community noise levels vary continuously. Most community noise is produced by many distant noise sources, which produce a relatively steady background noise having no identifiable source. These distant sources change gradually throughout the day and include traffic, wind in trees, and distant industrial activities. Superimposed on this slowly varying background is a succession of identifiable noise events of brief duration. These include nearby activities such as single vehicle passbys or aircraft flyovers which cause the community noise level to vary from instant to instant.

A single number called the equivalent sound level or L_{eq} is used to describe noise varying over a period of time. The L_{eq} is the average noise exposure level over a period of time (i.e., the total sound energy divided by the duration). It is the constant sound level which would contain the same acoustic energy as the varying sound level, during the same time period. The L_{eq} is useful in describing noise over a period of time with a single numerical value.

Discrete short duration transient noise events, such as aircraft flyovers, may be described by their maximum A-weighted noise level or by their sound exposure level (i.e., SEL). The SEL value is the preferred descriptor because measured results may be more reliably repeated and because the duration of the transient event is incorporated into the measure (thereby better relating to subjective response). Maximum levels of transient events vary with instantaneous propagation conditions while a total energy measure, like SEL, is more stable. The SEL of a transient event is a measure of the acoustic energy normalized to a constant duration of one second. Figure D-4 shows this relationship. The SEL differs from the L_{eq} in that it is the constant sound level containing the same acoustic energy as a one-second event, whereas the L_{eq} is the constant sound level containing the same acoustic energy over the entire measurement period. The SEL may be considered identical to the California standard Single Event Noise Exposure Level (i.e., SENEL).

SEL values may be summed on an energy basis to compute L_{eq} values over any period of time. This is useful in modeling noise in areas exposed to numerous transient noise events, such as communities around airports. Hourly L_{eq} values are called Hourly Noise Levels (i.e., HNL values).

In determining the daily measure of community noise, it is important to account for the difference in human response to daytime and nighttime noise. During the nighttime, exterior background noise levels are generally lower than in the daytime. Most household noise also decreases at night, and exterior noise intrusions become more noticeable. People are more sensitive to noise at night than during other periods of the day.

To account for human sensitivity to nighttime noise, the DNL (or L_{dn}) descriptor was adopted by the Environmental Protection Agency to describe community noise exposure from all sources. The DNL is called the day-night sound level and represents the 24-hour A-weighted equivalent sound level with a 10-dB penalty added for the nighttime noise between 10:00 pm to 7:00 am.

In California, the Community Noise Equivalent Level (CNEL) is the adopted standard. DNL and CNEL are typically computed by energy summation of HNL values, with the proper adjustment applied for the period of evening or night. The CNEL is computed identically to the DNL but with the addition of a 5-dB penalty for evening (i.e., 7:00 pm to 10:00 pm) noise. The CNEL value is typically less than 1 dB above the DNL value. Figure D-5 shows the adjustments applied for the DNL and CNEL measures. Noise exposure measures such as L_{eq}, SEL, HNL, DNL, and CNEL are all A-weighted, with units expressed in decibels (dB).

Subjective Response to Noise

The effects of noise on people can be classified into three general categories:

- Subjective effects of annoyance, nuisance, dissatisfaction.
- Interference with activities such as speech, sleep, and learning.
- Physiological effects such as anxiety or hearing loss.

The sound levels associated with community noise usually produce effects only in the first two categories. No universal measure for the subjective effects of noise has been developed, nor does a measure exist for the corresponding human reactions from noise annoyance. This is primarily due to the wide variation in individual attitude regarding the noise source(s).

An important factor in assessing a person's subjective reaction is to compare the new noise environment to the existing noise environment. In general, the more a new noise exceeds the existing, the less acceptable it is. Therefore, a new noise source will be judged more annoying in a quiet area than it would be in a noisier location.

Knowledge of the following relationships is helpful in understanding how changes in noise and noise exposure are perceived.

- Except under special conditions, a change in sound level of 1 dB cannot be perceived.
- Outside of the laboratory, a 3-dB change is considered a just-noticeable difference.
- A change in level of at least 5 dB is required before any noticeable change in community response would be expected.
- A 10-dB change is subjectively heard as an approximate doubling in loudness and almost always causes an adverse community response.

Combination of Sound Levels

Because we perceive both the level and frequency of sound in a non-linear way, the decibel scale is used to describe sound levels. The frequency scale is also measured in logarithmic increments. Decibels, measuring sound energy, combine logarithmically. A doubling of sound energy (for instance, from two identical automobiles passing simultaneously) creates a 3-dB increase (i.e., the resultant sound level is the sound level from a single passing automobile plus 3 dB). The rules for decibel addition used in community noise prediction are:

- If two sound levels are within 1 dB of each other, their sum is the highest value plus 3 dB.
- If two sound levels are within 2 to 4 dB of each other, their sum is the highest value plus 2 dB.
- If two sound levels are within 5 to 9 dB of each other, their sum is the highest value plus 1 dB.
- If two sound levels are greater than 9 dB apart, the contribution of the lower value is negligible and the sum is simply the higher value.

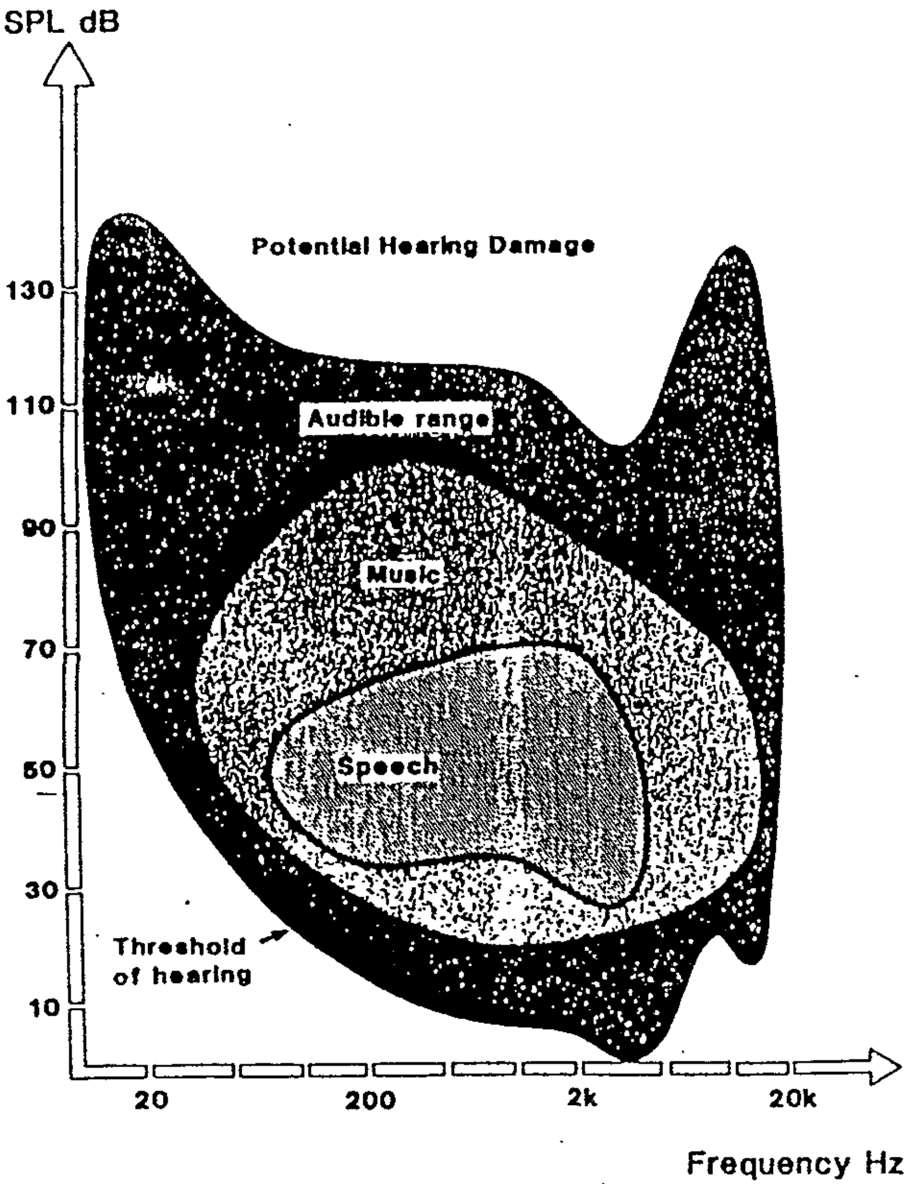


FIGURE D-1 RANGE OF SOUND SPECTRA

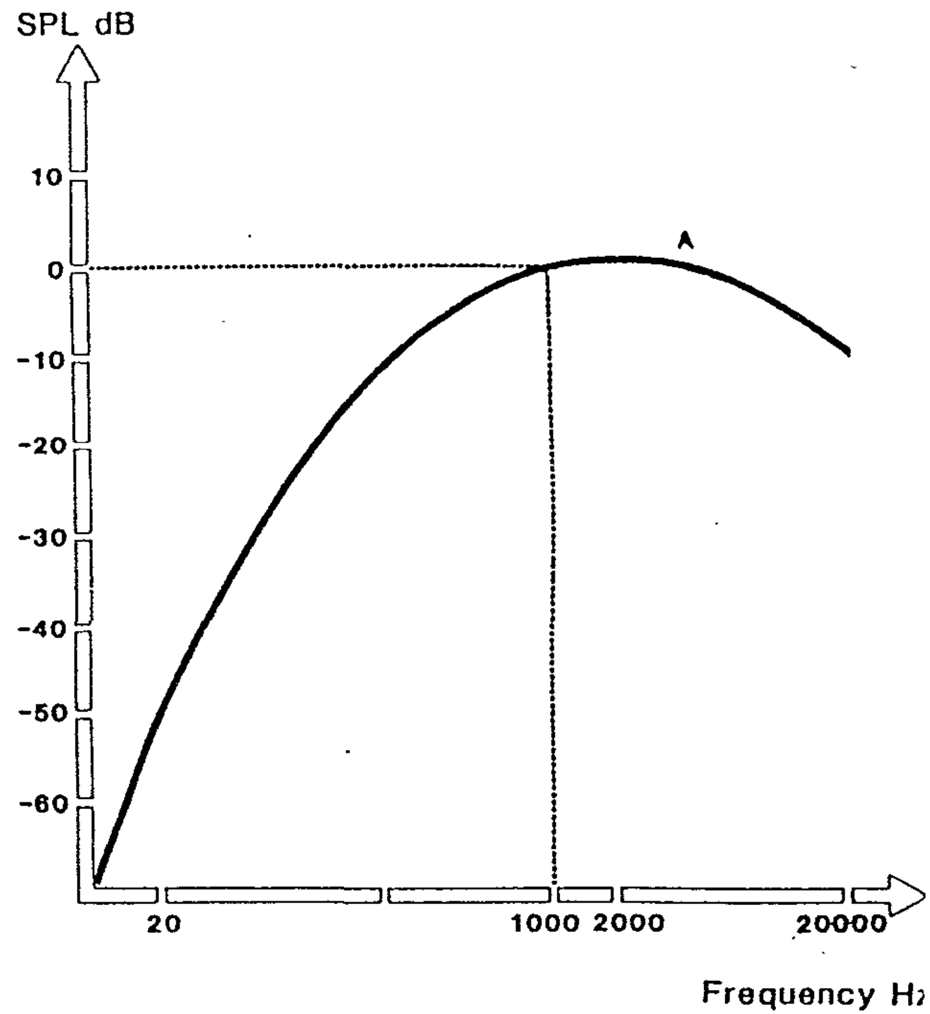
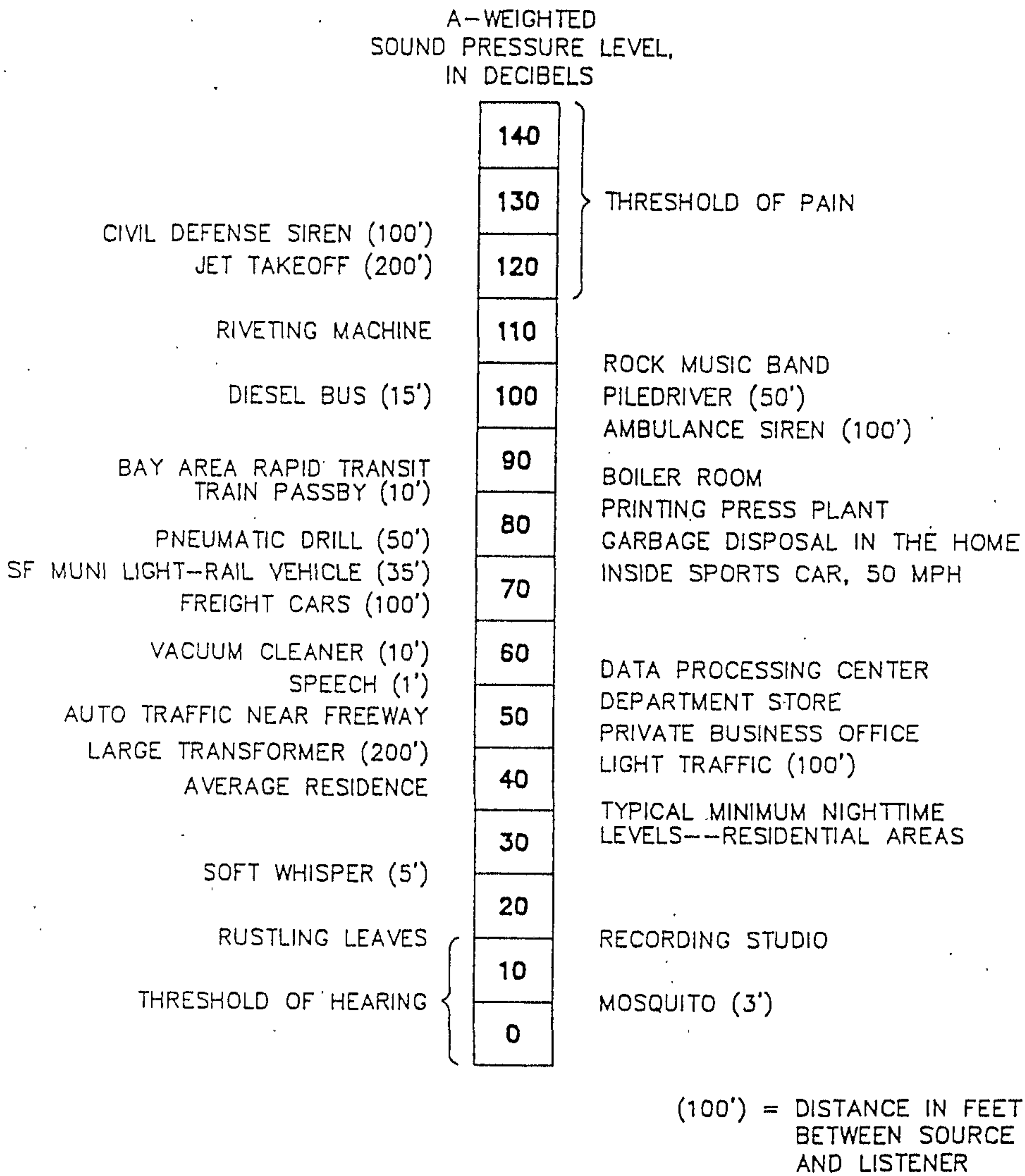


FIGURE D-2 A-WEIGHTING NETWORK



TYPICAL SOUND LEVELS
MEASURED IN THE ENVIRONMENT
AND INDUSTRY

FIGURE D-3

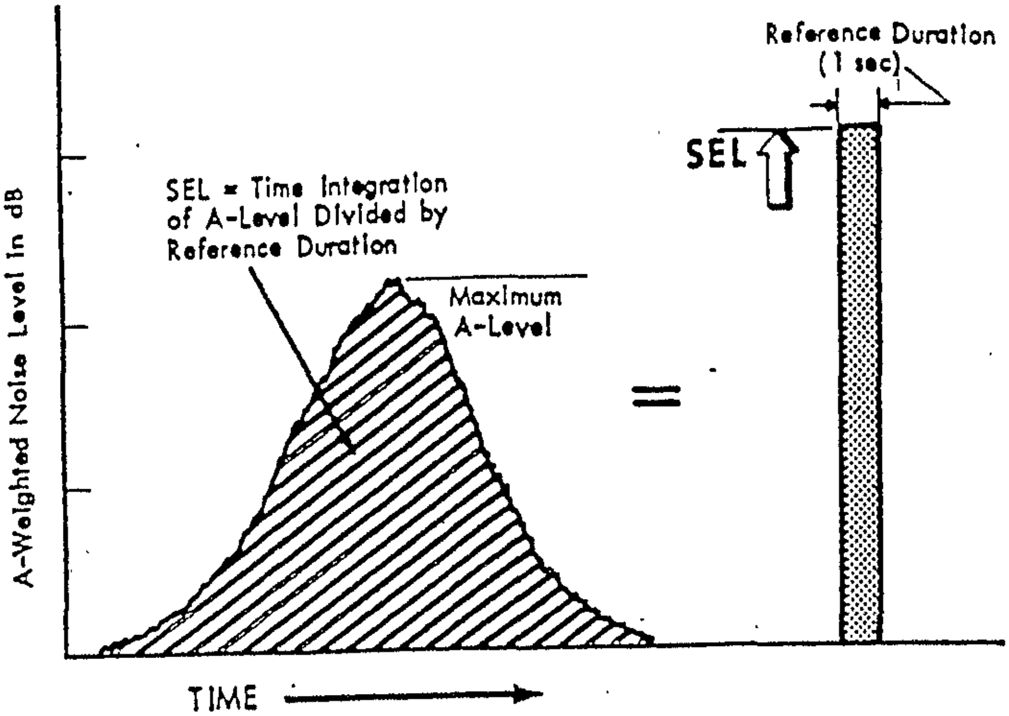


FIGURE D-4 SOUND EXPOSURE LEVEL

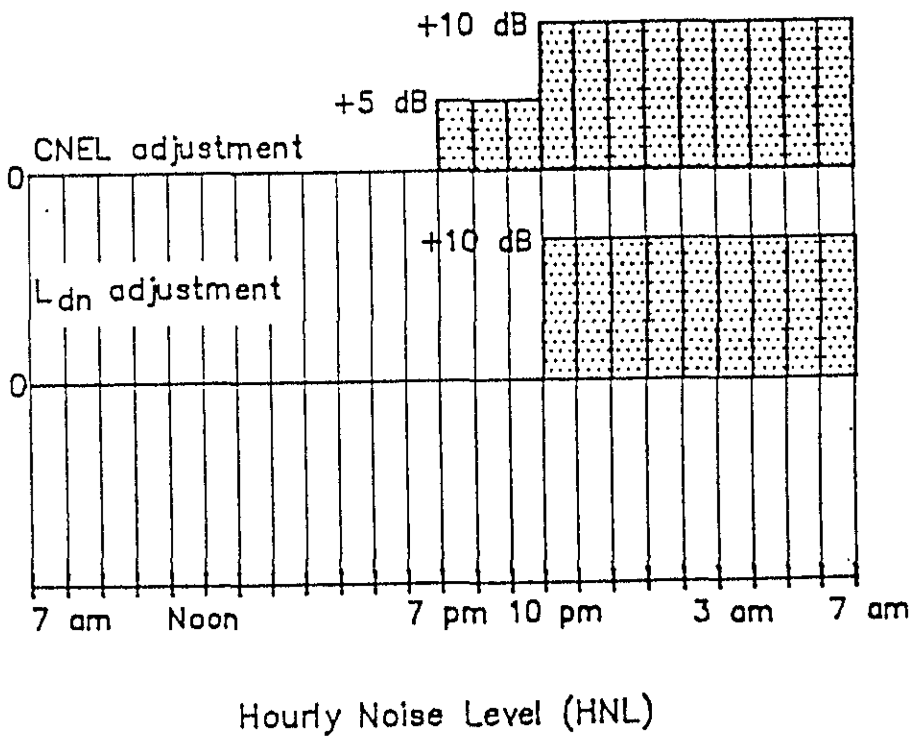


FIGURE D-5 HOURLY NOISE LEVELS AND ANNUAL METRICS